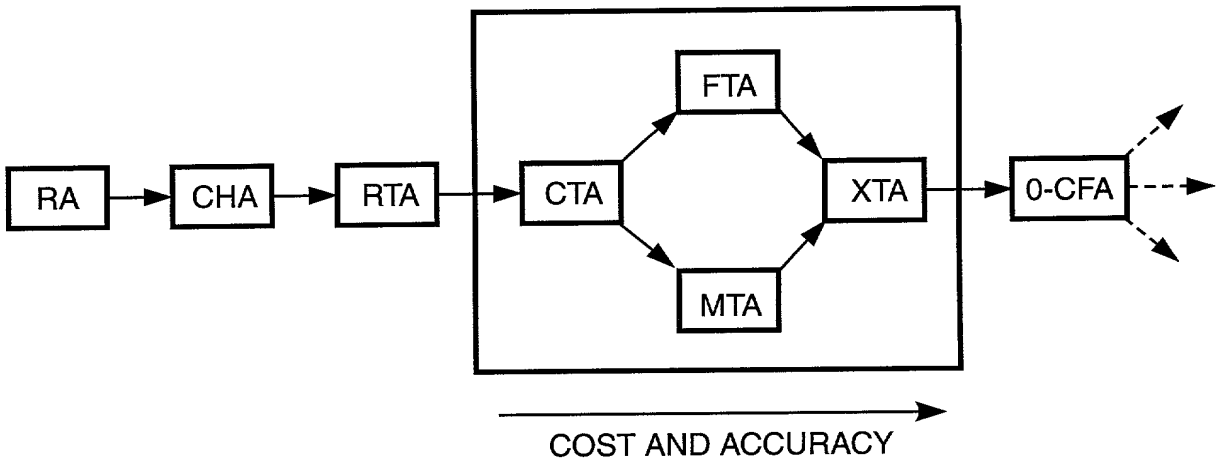


100

FIG. 1

BENCHMARK	# CLASSES	# METHODS	# FIELDS (REFERENCE-TYPED)	# VIRTUAL CALL SITES
Hanoi	44	379	232 (107)	285
Ice Browser	76	761	500 (253)	922
mBird	2,050	17,956	6739 (4284)	3,269
Cindy	468	4,449	3075 (1677)	5,085
CindyApplet	468	4,449	3075 (1677)	2,502
eSuite Sheet	588	5,590	4305 (1412)	4,459
eSuite Chart	733	8,302	5448 (2141)	8,074
javaFig 1.43	161	2,108	1526 (971)	3,482
BLOAT	282	2,677	1255 (541)	6,623
JAX 6.3	309	2,754	1252 (579)	3,836
javac	210	1,512	1107 (406)	3,621
Res. System	2,332	21,495	12487 (6334)	23,640

200

FIG. 2

BENCHMARK	RTA	MTA			FTA			XTA		
	# types	# types	# types/method (avg)		# types	# types/method (avg)		# types	# types/method (avg)	
Hanoi	19	19	7.1	37.3%	19	3.8	20.0%	19	2.8	14.8%
Ice Broser	59	59	23.4	39.7%	59	7.1	12.0%	59	4.5	7.7%
mBird	178	178	90.0	50.6%	178	13.3	7.5%	178	11.6	6.5%
Cindy	238	237	153.2	64.6%	237	36.5	15.4%	237	28.3	11.9%
CindyApplet	105	104	64.6	62.1%	104	17.2	16.5%	104	13.9	13.4%
eSuite Sheet	174	174	96.0	55.2%	174	21.1	12.1%	174	13.8	7.9%
eSuite Chart	303	303	224.1	74.0%	303	48.6	16.0%	303	24.0	7.9%
javaFig 1.43	110	110	73.4	66.7%	110	21.2	19.3%	110	17.1	15.5%
BLOAT	209	209	163.8	78.4%	209	44.7	21.4%	209	42.4	20.3%
JAX 6.3	221	221	70.9	32.1%	221	10.0	4.5%	221	8.3	3.8%
javac	171	171	106.4	62.2%	171	39.9	23.3%	171	35.5	20.8%
Res. System	1,174	1174	833.8	71.0%	1172	228.2	19.5%	1172	200.0	17.1%
AVERAGE				57.8%			15.6%			12.3%

FIG. 3 300

BENCHMARK	RTA	MTA	FTA	XTA	MTA/RTA	FTA/RTA	XTA/RTA
Hanoi	0.2	1.1	1.0	1.2	5.5	5.0	6.0
Ice Browser	0.4	1.7	2.4	2.1	4.3	6.0	5.3
mBird	1.1	4.8	5.2	5.8	4.4	4.7	5.3
Cindy	2.0	10.8	8.7	9.3	5.4	4.4	4.7
CindyApplet	0.7	3.0	2.4	2.6	4.3	3.4	3.7
eSuite Sheet	1.5	5.4	6.4	6.9	3.6	4.3	4.6
eSuite Chart	7.0	33.0	24.3	19.9	4.7	3.5	2.8
javaFig 1.43	0.8	3.4	4.5	4.9	4.3	5.6	6.1
BLOAT	1.8	13.1	7.9	8.7	7.3	4.4	4.8
JAX 6.3	1.2	3.4	3.2	3.5	2.8	2.7	2.9
javac	1.2	12.1	8.9	10.0	10.1	7.4	8.3
Res. System	44.5	329.4	309.1	250.2	7.4	6.9	5.6
AVERAGE					5.3	4.9	5.0

FIG. 8 800

BENCHMARK	RTA	MTA	FTA	XTA	(RTA-MTA)/RTA	(RTA-FTA)/RTA	(RTA-XTA)/RTA
Hanoi	183	179	178	178	2.2%	2.7%	2.7%
Ice Browser	644	644	643	643	0.0%	0.2%	0.2%
mBird	1,862	1,855	1,825	1,824	0.4%	2.0%	2.0%
Cindy	2,437	2,412	2,404	2,403	1.0%	1.4%	1.4%
CindyApplet	1,237	1,209	1,203	1,202	2.3%	2.7%	2.8%
eSuite Sheet	2,414	2,400	2,385	2,367	0.6%	1.2%	1.9%
eSuite Chart	4,428	4,419	4,313	4,296	0.2%	2.6%	3.0%
javaFig 1.43	1,441	1,435	1,413	1,411	0.4%	1.9%	2.1%
BLOAT	2,143	2,142	2,120	2,091	0.0%	1.1%	2.4%
JAX 6.3	1,900	1,894	1,894	1,892	0.3%	0.3%	0.4%
javac	1,366	1,366	1,366	1,366	0.0%	0.0%	0.0%
Res. System	11,232	11,227	11,204	11,201	0.0%	0.2%	0.3%
AVERAGE					0.6%	1.4%	1.6%

FIG. 4 400

BENCHMARK	RTA	MTA	FTA	XTA	(RTA-MTA)/RTA	(RTA-FTA)/RTA	(RTA-XTA)/RTA
Hanoi	400	386	382	379	3.5%	4.5%	5.3%
Ice Browser	1,594	1,594	1,593	1,588	0.0%	0.1%	0.4%
mBird	8,061	8,036	7,772	7,760	0.3%	3.6%	3.7%
Cindy	15,457	14,729	11,331	10,967	4.7%	26.7%	29.0%
CindyApplet	5,223	4,490	4,399	4,347	4.5%	15.8%	16.8%
eSuite Sheet	7,171	7,149	7,093	7,071	0.3%	1.1%	1.4%
eSuite Chart	14,669	14,648	13,857	13,771	0.1%	5.5%	6.1%
javaFig 1.43	5,128	5,064	4,963	4,961	1.2%	3.2%	3.3%
BLOAT	19,384	18,772	16,704	16,672	3.2%	13.8%	14.0%
JAX 6.3	7,053	7,018	6,904	6,895	0.5%	2.1%	2.2%
javac	13,154	13,154	13,115	13,113	0.0%	0.3%	0.3%
Res. System	46,130	45,944	44,792	44,412	0.4%	2.9%	3.7%
AVERAGE					1.6%	6.6%	7.2%

FIG. 5 500

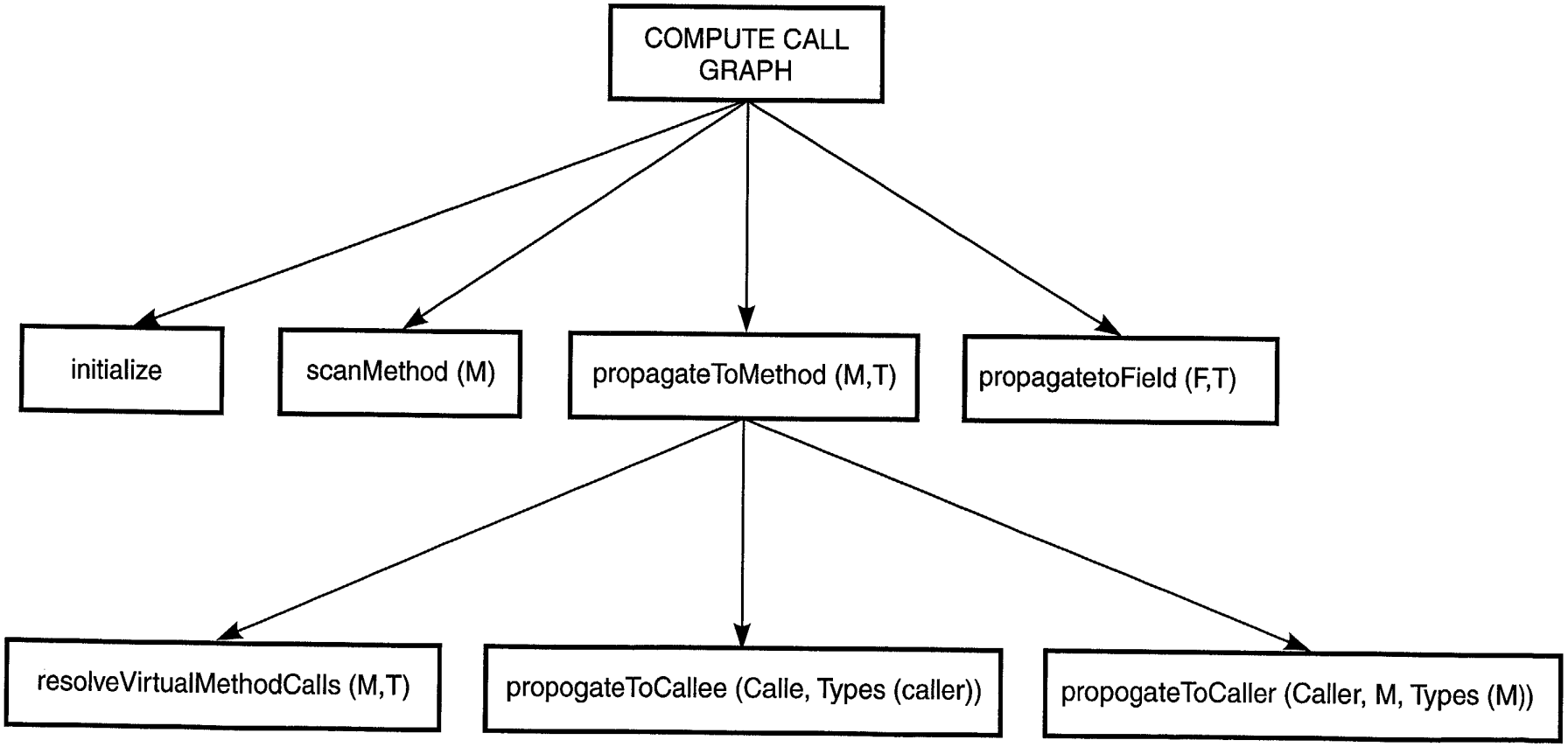
BENCHMARK	RTA			MTA			FTA			XTA		
	unreached	mono	poly	unreached	mono	poly	unreached	mono	poly	unreached	mono	poly
Hanoi	34.0%	61.6%	4.4%	34.0%	62.3%	3.7%	34.0%	62.7%	3.3%	34.0%	62.7%	3.3%
Ice BrowSer	4.0%	91.4%	4.7%	4.0%	91.4%	4.7%	4.0%	91.4%	4.7%	4.0%	91.6%	4.5%
mBird	14.2%	73.4%	12.3%	14.2%	73.5%	12.2%	17.4%	70.8%	11.8%	17.4%	70.9%	11.7%
Cindy	49.3%	45.0%	5.7%	49.5%	45.0%	5.5%	49.4%	45.2%	5.4%	49.4%	45.5%	5.0%
CindyApplet	72.0%	24.6%	3.4%	72.1%	24.6%	3.3%	72.3%	24.4%	3.3%	72.3%	24.5%	3.2%
eSuite Sheet	28.1%	68.4%	3.5%	28.1%	68.4%	3.5%	28.1%	69.1%	2.8%	28.2%	69.1%	2.8%
eSuite Chart	13.3%	76.6%	10.1%	13.3%	76.6%	10.1%	15.7%	75.7%	8.7%	15.7%	76.0%	8.3%
javaFig 1.43	9.1%	87.1%	3.9%	9.1%	87.4%	3.6%	9.7%	87.2%	3.1%	9.7%	87.2%	3.1%
BLOAT	6.6%	82.4%	11.1%	6.6%	82.4%	11.1%	6.7%	82.5%	10.8%	7.0%	82.2%	10.8%
JAX 6.3	18.7%	75.9%	5.4%	18.9%	75.7%	5.4%	18.9%	76.6%	4.5%	18.9%	76.8%	4.3%
javac	3.0%	77.6%	19.4%	3.0%	77.6%	19.4%	3.0%	77.6%	19.4%	3.0%	77.7%	19.3%
Res. System	18.1%	72.0%	9.9%	18.1%	72.2%	9.7%	18.2%	73.1%	8.7%	18.2%	74.0%	7.9%
AVERAGE			7.8%			7.7%			7.2%			7.0%

600

FIG. 6

BENCHMARK	mono->unreached	mono->mono	poly->unreached	poly->mono	poly->poly
Hanoi	0 (MTA)	266 (MTA)	0 (MTA)	3 (MTA)	16 (MTA)
	0 (FTA)	266 (FTA)	0 (FTA)	5 (FTA)	14 (FTA)
	0 (XTA)	266 (XTA)	0 (XTA)	5 (XTA)	14 (XTA)
Ice Browser	0 (MTA)	877 (MTA)	0 (MTA)	0 (MTA)	45 (MTA)
	1 (FTA)	876 (FTA)	0 (FTA)	0 (FTA)	45 (FTA)
	1 (XTA)	876 (XTA)	0 (XTA)	0 (XTA)	43 (XTA)
mBird	0 (MTA)	2,807 (MTA)	0 (MTA)	4 (MTA)	448 (MTA)
	141 (FTA)	2,266 (FTA)	8 (FTA)	12 (FTA)	442 (FTA)
	141 (XTA)	2,266 (XTA)	8 (XTA)	16 (XTA)	438 (XTA)
Cindy	8 (MTA)	4,510 (MTA)	0 (MTA)	9 (MTA)	548 (MTA)
	11 (FTA)	4,507 (FTA)	0 (FTA)	24 (FTA)	543 (FTA)
	14 (XTA)	4,504 (XTA)	0 (XTA)	52 (XTA)	515 (XTA)
CindyApplet	8 (MTA)	2,185 (MTA)	3 (MTA)	12 (MTA)	294 (MTA)
	21 (FTA)	2,172 (FTA)	3 (FTA)	3 (FTA)	303 (FTA)
	25 (XTA)	2,168 (XTA)	3 (XTA)	14 (XTA)	292 (XTA)
eSuite Sheet	1 (MTA)	4,272 (MTA)	2 (MTA)	0 (MTA)	184 (MTA)
	1 (FTA)	4,272 (FTA)	2 (FTA)	45 (FTA)	139 (FTA)
	2 (XTA)	4,271 (XTA)	2 (XTA)	45 (XTA)	139 (XTA)
eSuite Chart	2 (MTA)	7,186 (MTA)	2 (MTA)	1 (MTA)	883 (MTA)
	209 (FTA)	6,979 (FTA)	32 (FTA)	100 (FTA)	754 (FTA)
	217 (XTA)	6,971 (XTA)	32 (XTA)	135 (XTA)	719 (XTA)
javaFig 1.43	1 (MTA)	3,333 (MTA)	0 (MTA)	12 (MTA)	136 (MTA)
	23 (FTA)	3,311 (FTA)	2 (FTA)	26 (FTA)	120 (FTA)
	25 (XTA)	3,309 (XTA)	2 (XTA)	26 (XTA)	120 (XTA)
BLOAT	0 (MTA)	5,838 (MTA)	0 (MTA)	2 (MTA)	783 (MTA)
	26 (FTA)	5,812 (FTA)	0 (FTA)	20 (FTA)	765 (FTA)
	58 (XTA)	5,780 (XTA)	0 (XTA)	20 (XTA)	765 (XTA)
JAX 6.3	11 (MTA)	3,571 (MTA)	0 (MTA)	2 (MTA)	252 (MTA)
	11 (FTA)	3,571 (FTA)	0 (FTA)	46 (FTA)	208 (FTA)
	11 (XTA)	3,571 (XTA)	0 (XTA)	55 (XTA)	199 (XTA)
javac	0 (MTA)	2,898 (MTA)	0 (MTA)	0 (MTA)	723 (MTA)
	0 (FTA)	2,898 (FTA)	0 (FTA)	0 (FTA)	723 (FTA)
	0 (XTA)	2,898 (XTA)	0 (XTA)	2 (XTA)	721 (XTA)
Res. System	4 (MTA)	20,797 (MTA)	2 (MTA)	48 (MTA)	2,789 (MTA)
	22 (FTA)	20,779 (FTA)	14 (FTA)	324 (FTA)	2,501 (FTA)
	23 (XTA)	20,778 (XTA)	15 (XTA)	569 (XTA)	2,255 (XTA)

FIG. 7 700


COMPUTE CALL GRAPH
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scanMethod (M)
propagateToMethod (M,T)
propagatetoField (F,T)
resolveVirtualMethodCalls (M,T)
propogateToCallee (Calle, Types (caller))
propogateToCaller (Caller, M, Types (M))

900

FIG. 9